Kentucky Department of EDUCATION

Evidence-Based Instructional Practices

Establishing the Learning Environment and the Kentucky Academic Standards for Mathematics

The Establishing the Learning Environment Overview provides the research base associated with this evidence-based instructional practice.

What are connections between Evidenced-Based Instructional Practice #1: Establishing the Learning Environment and the *KAS for Mathematics*?

The driving question behind the development of the *KAS for Mathematics* was simple, "What is best for Kentucky students?" As a result, the *KAS for Mathematics* differs from previous standards in that they intentionally integrate content and practices in such a way that every Kentucky student will benefit mathematically. Put simply, the Standards for Mathematical Content define **what** students should understand and be able to do. Standards for Mathematical Practice define **how** students engage in mathematical thinking. To encourage the relationship between the standards for mathematical practice and content standards, the *KAS for Mathematics* highlights possible connections, as well as provides cluster level examples of what this relationship may look like for Kentucky students.

Within the *KAS for Mathematics* there are eight Standards of Mathematical Practice (SMPs) that illustrate critical student practices that support student learning in math across all content standards (K-12). In considering the impact engaging in the mathematical practices can have on student learning, it becomes clear that Establishing a Learning Environment (EBIP #1) that embraces intellectual risk-taking and encourages mistakes as a part of the learning process is critical. As teachers design instruction which places equal value on the development of mathematical content and mathematical practices, developing trusting relationships within the community of learners will improve the effectiveness of the delivery. Those relationships lay the groundwork for meaningful teacher and peer feedback allowing students to monitor their progress toward learning goals and providing students with opportunities to reflect on their own learning.

Effective implementation of the *KAS for Mathematics* requires cultivating a culture of math learning within the classroom - this culture encourages students to make sense and persevere when solving problems (MP.1), use quantities appropriately (MP.2), communicate and critique mathematical thinking (MP.3), model with mathematics (MP.4), strategically use tools (MP.5), attend to precision (MP.6), and to look for and apply structure (MP.7) and patterns (MP.8) to solve problems within grade-level content. To cultivate this kind of culture, teachers must model through words and actions the importance of grappling with content to build a deep understanding; they must equip students with the content

knowledge and problem solving tools to find multiple pathways to a given solution; and they must facilitate regular opportunities for students to engage in the practices of mathematics, including analyzing their own misconceptions and refining their approaches/communications as part of the learning process.

What are planning considerations for the successful implementation of the Evidenced-Based Instructional Practice #1: Establishing the Learning Environment to ensure that all students have equitable access and opportunity to learn the standards contained in the *KAS for Mathematics*?

- **Feedback** relies on high levels of trust between the teacher and the student and between students.
  - Teacher to Student: Provide age-appropriate authentic feedback that invites students to engage in deeper reflection about their own strengths.
  - Peer to Peer: Position students as mathematically competent by encouraging students to construct mathematical arguments and engage in the reasoning of others. Empower students to give and receive constructive feedback. As students engage in learning experiences that require them to listen to the argument of others, decide if they make sense and ask useful questions to clarify or improve the argument, it may be useful to implement discussion protocols to provide a safe environment for students to share their developing thinking (MP.3).
- **Self-efficacy and mindset** work together in determining a student's motivation and willingness to engage in the learning process.
  - Develop a shared understanding of and expectation for approaching mathematics with a growth mindset and for how that mindset will manifest within student self-talk and their communications with others.
  - Provide opportunities for students to think metacognitively and organize their own thoughts with given information. Embedded time and space for student reflection can have a significant impact on how well students are able to manage their emotions and express personal agency around the mathematics being learned.
- Welcome **errors as opportunities** for learning.
  - By thinking about when misconceptions are likely to arise in the lesson, teachers can plan to use strategies, such as Talk Moves, that will support students to clarify and advance their learning. Planning to use these strategies allows teachers to be ready to quickly take appropriate pedagogical action for many of their learners. Normalize mistake-making and celebrate intellectual risk-taking using strategies such as My Favorite No.
- Promote a **sense of belonging**.
  - Build a safe community where mathematical discourse supports active listening, promotes diverse perspectives and insights, and allows students to consider others' reasoning to advance their own mathematical understanding. Creating a learning community is essential for mathematical practices that are interpersonal by nature, such as MP.3.

    - Consider what teacher moves might help students strengthen reasoning and communication skills, along with ways to empower students to use similar strategies in collaborative groups. Attend to the ways in which students position one another as capable or not capable of doing mathematics and provide opportunities to elevate the voices of marginalized students, such as strategically sharing student work, student thinking and solutions (MP.3).
- Routinely ask questions that encourage students to **reflect on barriers** they may encounter and help them think about ways they can **overcome challenges**.
    - Consistently provide students, individually and collectively, with opportunities and support to engage in productive struggle as they grapple with mathematical ideas and relationships (NCTM, 2014).
    - Promote student engagement and identity by embedding systems and routines, such as Routines for Reasoning, to allow students to engage in productive struggle and take ownership of their progress and growth toward intended learning outcomes (MP.1). While specific routines may vary among educators and even across different class sessions, routines can help foster a sense of predictability and safety for students as they learn mathematics.
- Communicate that **students' thinking is valued** to build trust and rapport by asking questions that **elicit students' thinking**.
    - Lead class activities that offer students the opportunity to share their perspectives and learn from the perspectives of others. Enhance students' mathematical agency by including regular collaborative opportunities for students to work together with others as a team on modeling tasks that provide multiple pathways for success and that require reasoning and problem solving (MP.4).
    - Position students as competent and elevate the status of students by valuing different contributions students make when they share representations and make connections between these representations. Translating between multiple representations helps students understand each form represents the same relationship and provides a different perspective on the relationship (MP.3). Engage students in making connections among mathematical representations to deepen understanding of mathematics concepts and procedures as tools for problem solving (NCTM, 2014).

What strategies and resources can support the implementation of Evidence-Based Instructional Practice #1: Establishing the Learning Environment within the *KAS for Mathematics?*

Brain Research and Emotional Learning

For learning to occur, educators must not only focus on student's academic learning, but also on the social and emotional factors that affect student learning (McTighe & Willis, 2019). For more information on how the SMPs support teachers in creating and sustaining a culture of learning in math classrooms, visit:

- KDE's Implementing Social, Emotional and Academic Development (SEAD) within the *Kentucky Academic Standards (KAS) for Mathematics* resource library

- The focus of Integrating SEAD within the *KAS for Mathematics* is to encourage educators to look for authentic opportunities to interweave the development of one (or more) social emotional competencies with the development of the mathematics content and practices. A reflection sheet is provided to support educators in processing new learning and reflecting on instructional implications. Facilitation considerations guidance also is provided to support those facilitating a learning experience around Integrating SEAD within the *KAS for Mathematics* at the local level, and an overview video is available as an orientation to all the components.

Fostering Teacher-Student Relationships

Teachers should be viewed by their students as a "warm demander". A "warm demander" communicates personal warmth and positive regard toward students while at the same time demands they work toward high standards. These teachers provide concrete guidance and support for meeting the learning expectations, specific corrective feedback, and opportunities for processing information and culturally relevant meaning making (Hammond, 2015). For more information on educator practices to support teaching and learning in the mathematics classroom, visit:

- NCTM's *Effective Mathematics Teaching Practices*
  - NCTM's landmark publication *Principles to Actions* connects research with practice. The teaching of mathematics is complex. It requires teachers to have a deep understanding of the mathematical content that they are expected to teach and a clear view of how student learning of that mathematics develops and progresses across grades. It also calls for teachers to be skilled at using instructional practices that are effective in developing mathematics learning for all students. The eight Mathematics Teaching Practices describe the essential teaching skills derived from the research-based learning principles, as well as other knowledge of mathematics teaching that has emerged over the last two decades.

Establishing the Physical and Social Environment

The SMPs can support interpersonal and academic interactions within the mathematics classroom. For more information on how to explicitly introduce and authentically incorporate the SMPs within their instruction, visit:

- KDE's *Getting to Know the KAS for Mathematics Module specifically, Section 1C*
  - Section 1C focuses on the Standards for Mathematical Practice. Included are a Facilitator's Guide that provides suggestions for structuring each section of Module 1, recommended activities to prompt meaningful investigation of the *KAS for Mathematics* and guidance on talking points to use with the provided slideshows. Additional resources needed to engage with this module are the accompanying PowerPoint and Module at a Glance. The discovery task in Section 1C (SMP Sample Task Match Up) might be particularly powerful for teachers to engage in as the conversations around what the mathematical practices might look like in classrooms can be especially impactful.
- KDE's *Engaging the SMPs: Look Fors & Questions Stems*

- As a supplement to the *KAS for Mathematics*, the Engaging the SMPs resource provides guidance on ways teachers can design instruction to allow students to engage in the standards for mathematical practices. Engaging the SMPs resource includes Student Look-fors, Teacher Look-fors and potential Question Stems for each of the eight mathematical practices.

Improving Student Motivation

Students need to believe that they can be successful with the tasks they are assigned, feel they have some autonomy and self-direction in their activities and believe their abilities can grow and improve over time. For more information on creating a "culture of error" where students feel comfortable taking academic risks, struggling through high-quality tasks and discussing their misconceptions to advance their own learning, visit:

- KDE's *Building a Culture of Math Learning modules*
  - Developed through a partnership between KDE and Leading Educators, the learning experiences will allow educators to explore these instructional moves and connect them directly to the mathematical content and standards for mathematical practices within the *KAS for Mathematics*.
- KDE's *Standards Family Guides*
  - The Kentucky Academic Standards (KAS) Family Guides have been developed to help families familiarize themselves with the content of each grade level's standards. Each guide contains a standards overview for Reading & Writing, Mathematics, Science and Social Studies and is available in English and Spanish.